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DEVELOPMENT OF  
A *RECOMMENDATION BLANK*  
TO AID IN THE SELECTION OF  
SCIENTIFIC AND TECHNICAL PERSONNEL

A study conducted by Richardson, Bellows, Henry & Co., Inc.  
for the American Council on Education with funds provided  
by the Office of Naval Research

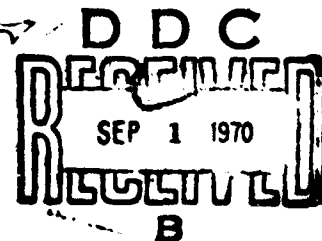
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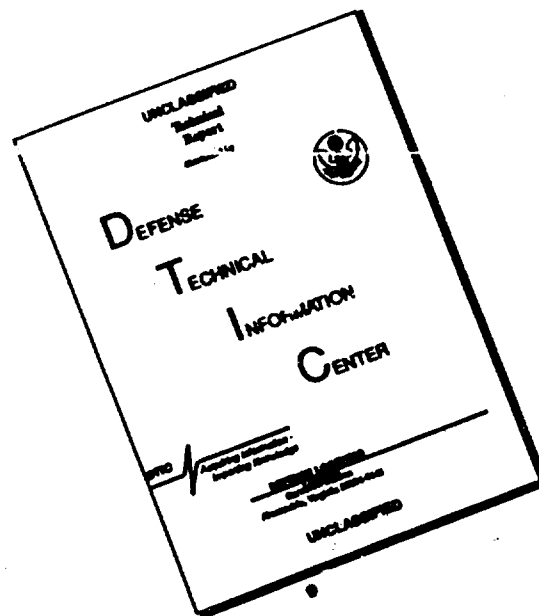
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# A RECOMMENDATION BLANK

## TO AID IN THE SELECTION OF SCIENTIFIC AND TECHNICAL PERSONNEL

### A. INTRODUCTION

1. Selection and placement officers frequently have commented on the lack of value of the usual letters of recommendation and reference forms. Persons referred to by applicants are apt to adhere to a safe middle ground of innocuous and generally favorable comments in describing the applicant or to give extremely high evaluation, even when the limitations of the recommendee are known. Letters of recommendation are too frequently characterized by generalities and stereotyped phrases with little or no information useful in evaluating the applicant's fitness for the job. In a few cases, of course, the recommender is so well known to the person responsible for selection that the statements made about the applicant are highly useful. Nevertheless, the ordinary references cannot be uniformly interpreted.

2. To meet the need for usable references on applicants for scientific and technical positions, the American Council on Education, under contract with the Office of Naval Research, made arrangements with Richardson, Bellows, Henry and Company to develop and validate an objective and scorable reference form. Three forms of objectively scored recommendation blanks were constructed and validated. (See Appendix A.)

3. Two comparable forms, 1-F and 2-F, use the forced-choice method. The other form, 3-N (non-forced-choice), was organized in a check list form. All three forms discriminated well between scientists rated by their superiors as "very effective" and those rated as "minimally effective." Suitable scoring keys were constructed for each form. Most persons will be able to complete the objective recommendation form for an applicant in less than twenty minutes.

### B. RECOMMENDATIONS

1. The use of the procedures developed in this study should be restricted to obtaining estimates of competence of applicants for physical science positions in research organizations. Their use for other classes of applicants may be misleading. While the material may be of value in other situations, further studies should be made in order to know the discriminative value and to set standards of minimum acceptability.

2. These rating forms should not be used as the sole means of obtaining estimates of an applicant's performance under former supervisors and professors. They should be only a part of a more comprehensive recommendation blank which would include other questions or ratings, as well as the "common denominator" of the forced-choice or check-list sections. The additional questions or ratings will provide additional information as to the particular strengths and weaknesses of applicants. There should be questions pertaining to his technical and background experience in the area, his ability to work within a set of policies, potential level of development, his ability to get along with professional and social associates, his ingenuity and creativeness, etc. Such data are needed for adequate placement of the individual employee. (See Appendix A for suggested forms.)

3. Possession or knowledge of the scoring keys must be restricted to those offices in which credentials are evaluated. As soon as recommendors gain knowledge of the scoring key, the value of these forms will decrease rapidly. On request to the Human Resources Division, Office of Naval Research, copies of the scoring keys will be made available to those who are planning to use these forms.

#### C. DEVELOPMENT OF RECOMMENDATION BLANKS

1. Recommendations are secured in order to determine the ability of an applicant on former jobs. The problem is, therefore, quite similar to that of evaluating the performance of employees. The research in this study was based upon extensive studies of work performance evaluation. These studies were based on certain assumptions and principles that have been carefully tested in practice. The basic ideas are:

- a. Most people can describe a subordinate quite accurately, but cannot be trusted to evaluate their performance objectively. It is, therefore, desirable to separate reporting on job performance from the evaluation of that performance.
- b. Language used in a performance report is most effective when it conforms to that of the persons reporting. The language used, therefore, is drawn directly from typical letters and reports.
- c. The significance of all reported aspects of job performance must be carefully checked by statistical methods in order to evaluate them properly.
- d. Opportunity must be given to any recommender to say favorable things about the person on whom he is reporting, with a chance to describe differences in people. Otherwise, no usable evaluations of individuals are possible.

2. The reference or recommendation forms presented in this study were constructed and validated on the same basis as are the more objective performance reports. In fact, a recommendation is a performance report which a selection officer may use as one evidence of the qualifications of an applicant for a job. A brief, selected bibliography on recommendation blanks and on forced-choice rating is given in Appendix D.

3. There are distinct phases or steps in the development of scorable recommendation blanks. After defining the class of persons to whom the procedure is to be applied, the steps, briefly, are as follows:

- a. Amassing the words and phrases which are used in describing individuals with reference to their performance or probable performance in the kinds of jobs included. Four sources of such descriptive material were available for this job.
  - 1) Descriptions written by supervisors of more effective and less effective physical scientists employed by a large industrial research department.
  - 2) The study "Critical Requirements for Research Personnel" recently completed for the Office of Naval Research and the American Council on Education (based on observations and interviews in Naval research organizations).
  - 3) Letters of recommendation written by scientists in regard to scientists.
  - 4) The recommendation blanks for contestants in the Eighth Annual Science Talent Search conducted by Science Service.
- b. The approximately 600 descriptive words and phrases obtained were organized into three forms (about 200 words and phrases each) of the Information Sheets. (See Appendix B for sample of an Information Sheet and covering letter.) These were sent to the heads of departments of physics, chemistry, and engineering in universities—since they frequently recommend persons for scientific positions. Each department chairman was asked to accomplish the three forms—on the form stamped "best," rate one of his best advanced students; on the form stamped "poor," rate one of his minimally acceptable students; and on the unstamped form to indicate how favorable each item was as a description of a scientist. Two hundred fifty blanks were returned and used in this study. These provided the basis for the selection of the items to be used, for their patterns of organization into blocks, and for the construction of the scoring keys. On this basis, the semi-final copy for Forms E and F (forced-choice\*) and Form G (non-forced-choice) were constructed.
- c. Supervisors of scientists in several Navy research agencies, the Bureau of Standards, and the Brookhaven National Institute provided the validation sample. The three semi-final forms (E, F, and G) were randomly arranged in pairs (E and F, E and G, and F and G). Each supervisor was asked to complete one

\*Forced-choice refers to the fact that the person filling in the form is required to make a response relative to a limited group of choices. This usually is of the form "of these five descriptive statements, mark with an X that one which is most descriptive of the person being rated. Mark with an @ that statement which is least descriptive of the person being rated."

pair of these forms, one for one of his best scientists and one for one of his minimally acceptable scientists in accordance with a letter of directions accompanying the forms.\* (See Appendix C.) On the basis of these responses:

- 1) the preliminary keys were cross-validated, i.e., checked by testing on a second group,
- 2) the least effective materials in Forms E and F were eliminated, leaving 20 groups or blocks of items in each form,
- 3) revised scoring keys were developed for Forms E and F (in final forms, 1-F and 2-F). These still need to be tested on another sample.

No information was available as to the size of the group from which these men were selected, nor was it possible to determine how representative were these groups when compared with the population of physical scientists as a whole. However, the results of the study would indicate that the scientists reported upon in this research are sufficiently representative of the physical scientists employed by the Navy in research laboratories that the recommendation procedures can be considered as quite useful to aid in selecting such scientists for the Navy. Further validity studies should be made in order to determine the applicability of the procedures to other areas.

#### D. RESULTS

1. Budgetary procedures required that this study be completed within rigid time limits, necessitating certain deviations from the standard procedures used in constructing and validating such form. These modifications did not seriously affect the validity of the study, but they do make it impossible to report validity indices on a basis comparable to other studies.

2. To show the discrimination effected by these forms, scores obtained for Forms 1-F and 2-F are shown in Table 1. The difference in scores for the "best" and "poor" scientists shows little overlapping. If a random sample of scientists had been used, the range of scores would have been about the same, but with many more scores around the middle of the distribution. Similar data are shown in Table 2 for Form 3-H.

\*On the basis of the experience of this firm, it has been found that supervisors agree to a very high degree in naming the two or three best and the two or three least effective in a group. This has been found to be true in such widely divergent groups as scientists, doctors and clergymen in the military service, scientific and technical men in industry, supervisors and foremen, hourly-paid workers in industry, etc.

TABLE 1

Distribution of Scores Obtained by Use of Key 1

Score	Form 1-F		Form 2-F	
	"Best"	"Poor"	"Best"	"Poor"
76-80				
72-75			1	
68-71	12		6	
64-67	22		32	
60-63	21		21	
56-59	16	1	12	
52-55	8	0	2	
48-51	1	2	3	
44-47		5	1	3
40-43		5		6
36-39		10		5
32-35		11		9
28-31		8		6
24-27		5		15
20-23		13		13
16-19		12		2
12-15		6		4
8-11		1		3
4-7				1
0-3				
N	80	79	78	67
M	45.1		45.7	
$\sigma$	18.6		19.0	

TABLE 2

Distribution of Scores Obtained by Use of Key 1 for Form 3-M

Score	"Best"	"Poor"
30-		
28-29	4	
26-27	11	
24-25	21	
22-23	19	
20-21	9	
18-19	9	
16-17	6	
14-15	3	2
12-13		3
10-11		14
8-9		14
6-7	1	4
4-5		16
2-3		21
0-1		11
N	83	85



3. The distributions in Table 1 show no significant difference between the forms in either mean or standard deviation, and, in the light of their construction and validation, may be considered equivalent forms of the same instrument. No data were available for study of the intercorrelations of the three forms.

4. One may expect fairly consistent scores from these recommendation forms. The degree of consistency or, more technically, the reliability of each of the three forms has been estimated. For Forms 1-F, 2-F, and 3-N, the estimated reliability coefficients are .79, .84, and .77 respectively. The methods used are described in Appendix E.

#### E. ACKNOWLEDGEMENTS

1. Richardson, Bellows, Henry and Company expresses its thanks to the university physical science department chairmen for their cooperation in filling in the Information Sheets. The consistency of their judgments is reflected in the cross-validation of the scoring keys.

2. Thanks are here expressed to those scientist supervisors and administrative officers who participated in the validation of semi-final Forms E, F, and G. These persons are employed in the following agencies:

Naval Research Laboratory  
Ordnance Research Laboratory  
Naval Gun Factory  
David Taylor Model Basin  
Philadelphia Naval Shipyard  
Brooklyn Naval Shipyard  
Bureau of Standards  
Brookhaven National Institute

3. Much of the success of the project is due to the efforts of Dr. Ralph Hogan, Head, Manpower Branch, Human Resources Division, Office of Naval Research, in his function as liaison officer.

## APPENDIX A

FINAL FORMS 1-F, 2-F, AND 3-N  
INCLUDING SUGGESTED MATERIALS  
FOR COVER PAGE AND PART II

RECOMMENDATION BLANK  
*SCIENTIFIC AND TECHNICAL POSITIONS*

FORM 1-F

\_\_\_\_\_ has applied for a position as  
Name \_\_\_\_\_  
\_\_\_\_\_ in  
Job Title \_\_\_\_\_ Grade \_\_\_\_\_  
\_\_\_\_\_ and has given your  
Agency or Department \_\_\_\_\_  
name as a reference. The chief duties of the position for which he has applied  
are \_\_\_\_\_  
\_\_\_\_\_

Please complete this blank and return it as soon as possible. Both Parts I and II must be filled out carefully and completely in accordance with the directions if the applicant is to receive due consideration for the position. Use the enclosed self-addressed, stamped envelope to return the completed blank to:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\* \* \* \* \*

PART I. DESCRIPTION OF THE MAN

Part I consists of 20 blocks or groups of five descriptive statements. Each block has been shown to discriminate between the more effective and the less effective physical scientists on the job in research laboratories.

Read the statements in the first block carefully. Decide which one of the five statements is MOST DESCRIPTIVE of the behavior of the man as a scientific worker. Then, in the column headed Most, circle the letter corresponding to the statement you select. Next, decide which of the statements is LEAST DESCRIPTIVE of the man and, in the column headed Least, circle the letter that goes with the statement.

Then, go on to Block 2 and the successive blocks and do them in the same way. Answer every block. No ties or omissions are allowed.

\* \* \* \* \*

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<p>Most Least 1.</p> <p>A A Never satisfied with superficial answers.</p> <p>B B Easily breaks problems down into component parts.</p> <p>C C Wants to be included in every activity and conversation.</p> <p>D D Uses more complex equipment than necessary.</p> <p>E E Does not push self or ideas.</p>	<p>Most Least 6.</p> <p>A A Devoid of ideas.</p> <p>B B Keen observer.</p> <p>C C Gathers data before drawing conclusions.</p> <p>D D Quiet and retiring.</p> <p>E E Has many accidents with his apparatus.</p>
<p>Most Least 2.</p> <p>A A Improvises with equipment.</p> <p>B B Few interests.</p> <p>C C Helps support himself with outside jobs.</p> <p>D D Reluctant to accept help from others.</p> <p>E E Needs little supervision.</p>	<p>Most Least 7.</p> <p>A A Avoids the practical.</p> <p>B B Doesn't talk much.</p> <p>C C Enjoys his work.</p> <p>D D Willing to proceed on tentative data.</p> <p>E E Gives vague answers to questions.</p>
<p>Most Least 3.</p> <p>A A Has to be driven out of laboratory.</p> <p>B B Easy to talk to.</p> <p>C C Avoids the practical.</p> <p>D D Interested in researches of others.</p> <p>E E Unimaginative.</p>	<p>Most Least 8.</p> <p>A A Highly diversified interests.</p> <p>B B Adaptable.</p> <p>C C Independent in his thinking.</p> <p>D D Tends to give too many details.</p> <p>E E Jokes about his status.</p>
<p>Most Least 4.</p> <p>A A Hardly looks for new methods.</p> <p>B B Reasoning always sound.</p> <p>C C No qualms about challenging the experts.</p> <p>D D Stubborn in argument.</p> <p>E E Never makes decisions until he must.</p>	<p>Most Least 9.</p> <p>A A Modifies procedure as soon as unforeseen conditions arise.</p> <p>B B Accepts suggestions readily and willingly.</p> <p>C C Clumsy.</p> <p>D D Illogical.</p> <p>E E Always looking for short cuts.</p>
<p>Most Least 5.</p> <p>A A Gets confused under pressure.</p> <p>B B Raises provocative questions about theory.</p> <p>C C Very thorough.</p> <p>D D Does not work to limit of ability.</p> <p>E E Underestimates own ability.</p>	<p>Most Least 10.</p> <p>A A He likes the limelight.</p> <p>B B Practices good English usage.</p> <p>C C Gambles time and energy on long-shot ideas.</p> <p>D D Always appears enthusiastic about work.</p> <p>E E Accepts responsibility only when forced on him.</p>

<p>Most Least 11.</p> <p>A A Lacks personal aggressiveness.</p> <p>B B Doesn't miss obvious errors.</p> <p>C C Has many accidents with his apparatus.</p> <p>D D Fails to see problems through to finish.</p> <p>E E Tactful.</p>	<p>Most Least 16.</p> <p>A A Enjoys being with others.</p> <p>B B Keeps his ideas to himself.</p> <p>C C Does not go beyond specific instructions.</p> <p>D D Investigates superficial aspects of problems.</p> <p>E E Takes responsibility for own work.</p>
<p>Most Least 12.</p> <p>A A Studies problem thoroughly before going to work.</p> <p>B B Will hold to a point until proven wrong.</p> <p>C C Attempts to bluff way.</p> <p>D D Reckless.</p> <p>E E Prefers to work alone.</p>	<p>Most Least 17.</p> <p>A A Keeps opinions of other people to self.</p> <p>B B Uses equipment or materials successful in related fields, without specifying necessary modifications.</p> <p>C C Lacking in knowledge.</p> <p>D D Does routine work well.</p> <p>E E Does not work to limit of ability.</p>
<p>Most Least 13.</p> <p>A A Worries about unimportant details.</p> <p>B B Neat in personal appearance.</p> <p>C C Always accepts additional work with a smile.</p> <p>D D Not definite in goals.</p> <p>E E Not easily led.</p>	<p>Most Least 18.</p> <p>A A Helps support himself with outside jobs.</p> <p>B B Appreciates the problems of others.</p> <p>C C Disturbed easily.</p> <p>D D Develops own methods when necessary.</p> <p>E E Messes up.</p>
<p>Most Least 14.</p> <p>A A Selects project which cannot be handled with available equipment.</p> <p>B B Profits by past mistakes.</p> <p>C C Day-dreamer.</p> <p>D D Dogged persistence.</p> <p>E E Has the confidence of associates.</p>	<p>Most Least 19.</p> <p>A A Follows directions well, but is not inventive.</p> <p>B B Often ahead of schedule.</p> <p>C C Needs frequent encouragement.</p> <p>D D Able to handle others.</p> <p>E E Uses trial and error methods.</p>
<p>Most Least 15.</p> <p>A A Knows what he wants.</p> <p>B B Efficiency "expert."</p> <p>C C Patient.</p> <p>D D Has trouble grasping things rapidly.</p> <p>E E Brilliant coordinator of established ideas but not original.</p>	<p>Most Least 20.</p> <p>A A Puts his all into anything he does.</p> <p>B B Not resourceful.</p> <p>C C Does not like to be interrupted.</p> <p>D D Tackles problems beyond his ability.</p> <p>E E Analytical.</p>

## PART II. SUMMARY OF RECOMMENDATIONS

Please summarize your recommendations concerning this applicant by marking each statement below as follows: Circle

- + if the applicant is exceptional or outstanding in the area.  
O if he is adequate, or about average for a worker at his level.  
- if he is deficient, or below average for a worker at his level.  
U if you do not know him well enough to rate him in the area.

- |  |   |   |   |   |
|--|---|---|---|---|
| 1. Technical background and experience . . . . .   | + | 0 | - | U |
| 2. Executive ability, i.e., ability to formulate and execute policies, to organize and direct the work of others . . . . . | + | 0 | - | U |
| 3. Potential level of development . . . . .  | + | 0 | - | U |
| 4. Ability to get along with people . . . . .  | + | 0 | - | U |
| 5. Ingenuity, creative ability, inventiveness . . . . .  | + | 0 | - | U |
| 6. Educational background . . . . .  | + | 0 | - | U |

REMARKS. Use this space to describe the applicant in any area you have marked + or - above, giving specific examples of what he has done or failed to do which led you to rate him as you did. Are his major strengths and weaknesses adequately described above? Give any information needed to make this description of the man complete and pertinent. Attach an additional sheet if more space is needed.

Please supply the following information:

How long have you known the applicant?\_\_\_\_\_ In what capacity?\_\_\_\_\_

What was your relationship to him? \_\_\_\_\_

**Your name** \_\_\_\_\_

College or Firm \_\_\_\_\_

Ad 913

**RECOMMENDATION BLANK**  
**SCIENTIFIC AND TECHNICAL POSITIONS**

**FORM 2-F**

\_\_\_\_\_ has applied for a position as  
Name  
\_\_\_\_\_, \_\_\_\_\_ in  
Job Title Grade  
\_\_\_\_\_ and has given your  
Agency or Department  
name as a reference. The chief duties of the position for which he has applied  
are \_\_\_\_\_  
\_\_\_\_\_

Please complete this blank and return it as soon as possible. Both Parts I and II must be filled out carefully and completely in accordance with the directions if the applicant is to receive due consideration for the position. Use the enclosed self-addressed, stamped envelope to return the completed blank to:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\* \* \* \* \*

**PART I. DESCRIPTION OF THE MAN**

Part I consists of 20 blocks or groups of five descriptive statements. Each block has been shown to discriminate between the more effective and the less effective physical scientists on the job in research laboratories.

Read the statements in the first block carefully. Decide which one of the five statements is MOST DESCRIPTIVE of the behavior of the man as a scientific worker. Then, in the column headed Most, circle the letter corresponding to the statement you select. Next, decide which of the statements is LEAST DESCRIPTIVE of the man and, in the column headed Least, circle the letter that goes with the statement.

Then, go on to Block 2 and the successive blocks and do them in the same way. Answer every block. No ties or omissions are allowed.

\* \* \* \* \*

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<p>Most Least 1.</p> <p>A A Aloof.</p> <p>B B Handles well several jobs at a time.</p> <p>C C Careless in handling equipment.</p> <p>D D Obtains needed information from uncommon sources.</p> <p>E E Not easily led.</p>	<p>Most Least 6.</p> <p>A A Stubborn in argument.</p> <p>B B Excellent memory for diagrams and drawings.</p> <p>C C Plenty of common sense.</p> <p>D D Little intellectual curiosity.</p> <p>E E Absent-minded.</p>
<p>Most Least 2.</p> <p>A A Mechanical aptitude above average.</p> <p>B B Chooses wisely between accuracy and speed.</p> <p>C C Always has the last word.</p> <p>D D Apathetic.</p> <p>E E Highly diversified interests.</p>	<p>Most Least 7.</p> <p>A A Self-centered.</p> <p>B B Calculations are rapid and accurate.</p> <p>C C Clumsy in handling equipment.</p> <p>D D Does not put off doing things.</p> <p>E E Always looking for shortcuts.</p>
<p>Most Least 3.</p> <p>A A Dogged persistence.</p> <p>B B Plans ahead carefully.</p> <p>C C Clumsy.</p> <p>D D Accepted as a leader among associates.</p> <p>E E Doesn't see the over-all picture.</p>	<p>Most Least 8.</p> <p>A A Likes to work alone.</p> <p>B B Thinks problem through before seeking aid.</p> <p>C C He is a sloppy housekeeper in the laboratory.</p> <p>D D A follower rather than a leader.</p> <p>E E Accepts criticism in an intelligent manner.</p>
<p>Most Least 4.</p> <p>A A Little insight into significance of problems.</p> <p>B B Slow to find fault with other people.</p> <p>C C Always carries out orders.</p> <p>D D Lacks drive.</p> <p>E E Always looking for shortcuts.</p>	<p>Most Least 9.</p> <p>A A Excellent mechanic.</p> <p>B B Tremendous curiosity.</p> <p>C C Dislikes physical exertion.</p> <p>D D Fails to seek clarification of instructions until mistake is made.</p> <p>E E Knows how to obtain cooperation.</p>
<p>Most Least 5.</p> <p>A A Takes as little responsibility as possible.</p> <p>B B Does well with tools.</p> <p>C C Wastes time on unimportant things.</p> <p>D D Controls emotions completely.</p> <p>E E Stresses theory over practice.</p>	<p>Most Least 10.</p> <p>A A Improvises with equipment.</p> <p>B B Over-emphasizes details.</p> <p>C C Gives up easily.</p> <p>D D Very abrupt.</p> <p>E E Studies a problem adequately before making decisions or conclusions.</p>



<p>Most Least 11.</p> <p>A A Gives up even though he thinks he is right.</p> <p>B B He does not evaluate self highly enough.</p> <p>C C Makes the most of source materials.</p> <p>D D Has poise</p> <p>E E Frequently omits essential details in a routine operation.</p>	<p>Most Least 16.</p> <p>A A Evaluates work only in terms of objectives.</p> <p>B B Willing to listen.</p> <p>C C Fails to foresee difficulties.</p> <p>D D Rarely looks for new methods.</p> <p>E E Willing to work overtime if required.</p>
<p>Most Least 12.</p> <p>A A Follows the group.</p> <p>B B Holds temper.</p> <p>C C Fails to investigate unexpected results in work.</p> <p>D D Conventional.</p> <p>E E Always on the job when needed.</p>	<p>Most Least 17.</p> <p>A A No outside interests.</p> <p>B B Respects the knowledge of his fellow workers.</p> <p>C C Possesses little technical ability.</p> <p>D D Respected rather than liked.</p> <p>E E Always willing to consider suggestions.</p>
<p>Most Least 13.</p> <p>A A Athletic.</p> <p>B B Takes nothing for granted.</p> <p>C C Uses "lab jargon" in reports.</p> <p>D D Hesitates to offer new ideas.</p> <p>E E Has fine analytical mind.</p>	<p>Most Least 18.</p> <p>A A Insistent on neat work.</p> <p>B B Helps support himself with outside jobs.</p> <p>C C Inclined to be moody.</p> <p>D D Considers all aspects of problems.</p> <p>E E Not very bright.</p>
<p>Most Least 14.</p> <p>A A Content with average work.</p> <p>B B Always looking for new approaches.</p> <p>C C Gives time and attention to small details of procedure.</p> <p>D D Keeps his ideas to himself.</p> <p>E E Too shy to be a leader.</p>	<p>Most Least 19.</p> <p>A A Applies theories from other fields to explain observed phenomena.</p> <p>B B Follows line of least resistance.</p> <p>C C Stresses theory over practice.</p> <p>D D Compromises too much.</p> <p>E E Creative.</p>
<p>Most Least 15.</p> <p>A A Incessantly concerned with details.</p> <p>B B Independent in his thinking.</p> <p>C C His conclusions don't follow premises.</p> <p>D D A good mixer.</p> <p>E E Uses equipment or materials successful in related fields without specifying necessary modifications.</p>	<p>Most Least 20.</p> <p>A A Hesitant in making decisions.</p> <p>B B Performs necessary routine and/or repetitious work without complaint.</p> <p>C C Gets along extremely well with all associates.</p> <p>D D Sometimes off the beam in logic.</p> <p>E E Sometimes too positive.</p>

PART II. SUMMARY OF RECOMMENDATIONS

Please summarize your recommendations concerning this applicant by marking each statement below as follows: Circle

- + if the applicant is exceptional or outstanding in the area.
- O if he is adequate, or about average for a worker at his level.
- if he is deficient, or below average for a worker at his level.
- U if you do not know him well enough to rate him in the area.

- |  |               |
|--|---------------|
| 1. Technical background and experience . . . . .   | +   O   -   U |
| 2. Executive ability, i.e., ability to formulate and<br>execute policies, to organize and direct the<br>work of others . . . . . | +   O   -   U |
| 3. Potential level of development . . . . .  | +   O   -   U |
| 4. Ability to get along with people . . . . .  | +   O   -   U |
| 5. Ingenuity, creative ability, inventiveness . . . . .  | +   O   -   U |
| 6. Educational background . . . . .  | +   O   -   U |

REMARKS. Use this space to describe the applicant in any area you have marked + or - above, giving specific examples of what he has done or failed to do which led you to rate him as you did. Are his major strengths and weaknesses adequately described above? Give any information needed to make this description of the man complete and pertinent. Attach an additional sheet if more space is needed.

Please supply the following information:

How long have you  
known the applicant?\_\_\_\_\_ In what capacity?\_\_\_\_\_

What was your relationship to him?\_\_\_\_\_

Your name\_\_\_\_\_

College or Firm\_\_\_\_\_

Address \_\_\_\_\_

RECOMMENDATION BLANK  
*SCIENTIFIC AND TECHNICAL POSITIONS*

FORM 3-N

\_\_\_\_\_ has applied for a position as  
Name

\_\_\_\_\_, \_\_\_\_\_ in  
Job Title Grade

\_\_\_\_\_ and has given your  
Agency or Department

name as a reference. The chief duties of the position for which he has  
applied are \_\_\_\_\_

\_\_\_\_\_  
Please complete this blank and return it as soon as possible. Both Parts  
I and II must be filled out carefully and completely in accordance with  
the directions if the applicant is to receive due consideration for the  
position. Use the enclosed self-addressed, stamped envelope to return  
the completed blank to:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\* \* \* \* \*

PART I. DESCRIPTION OF THE MAN

Part I consists of 50 statements which are descriptive of scientists.  
Rate the man on the basis of his performance as a scientist as follows:

In the space at the left of each statement, circle

- + if the statement is a good description of the man.
- ? if the statement and its opposite are about equally  
true of the man.
- if the opposite of the statement is a good descrip-  
tion of the man.
- U if you are unable to make a judgment.

Mark every item. Do not omit any of them.

\* \* \* \* \*

Prepared by  
RICHARDSON, BELLows, HENRY & CO., INC.  
224 East 33 Street, New York 16, N. Y.

<p>1.</p> <ul style="list-style-type: none"> <li>+ ? - U Willing to proceed on tentative data.</li> <li>+ ? - U Knows how to get a job done.</li> <li>+ ? - U Conventional.</li> <li>+ ? - U Tackles too many problems at one time.</li> <li>+ ? - U Enjoys being with others.</li> </ul>	<p>26.</p> <ul style="list-style-type: none"> <li>+ ? - U Ability for analyzing a problem is fair.</li> <li>+ ? - U Devoid of ideas.</li> <li>+ ? - U Rather reserved.</li> <li>+ ? - U Not adaptable.</li> <li>+ ? - U Continues to collect data after conclusiveness of results is evident.</li> </ul>
<p>6.</p> <ul style="list-style-type: none"> <li>+ ? - U Uses data without understanding their limitations.</li> <li>+ ? - U Ignores chance findings that suggest new problems.</li> <li>+ ? - U Boorish.</li> <li>+ ? - U Clumsy in handling equipment.</li> <li>+ ? - U Anxious to please superiors.</li> </ul>	<p>31.</p> <ul style="list-style-type: none"> <li>+ ? - U Interested in researches of others.</li> <li>+ ? - U Tremendous curiosity.</li> <li>+ ? - U Willing to work overtime if required.</li> <li>+ ? - U Questions validity of material in the literature.</li> <li>+ ? - U Tends to be self-centered.</li> </ul>
<p>11.</p> <ul style="list-style-type: none"> <li>+ ? - U Immense capacity for responsibility.</li> <li>+ ? - U Respected rather than liked.</li> <li>+ ? - U Work quality varies with interest.</li> <li>+ ? - U Thrives on praise.</li> <li>+ ? - U Does not work to the limit of ability.</li> </ul>	<p>36.</p> <ul style="list-style-type: none"> <li>+ ? - U Self-centered.</li> <li>+ ? - U Keeps opinions of other people to self.</li> <li>+ ? - U Slow to find fault with other people.</li> <li>+ ? - U A justified feeling of superiority.</li> <li>+ ? - U Brilliant coordinator of established ideas, but not original.</li> </ul>
<p>16.</p> <ul style="list-style-type: none"> <li>+ ? - U Excellent memory for diagrams and drawings.</li> <li>+ ? - U Stresses theory over practice.</li> <li>+ ? - U Does not anticipate difficulties that might arise at later stages.</li> <li>+ ? - U Chooses wisely between accuracy and speed.</li> <li>+ ? - U Considers consequences of alternative approaches.</li> </ul>	<p>41.</p> <ul style="list-style-type: none"> <li>+ ? - U Very abrupt.</li> <li>+ ? - U Lacks initiative.</li> <li>+ ? - U Does a minimum amount of work.</li> <li>+ ? - U Doesn't see the over-all picture.</li> <li>+ ? - U Tends to let things slide.</li> </ul>
<p>21.</p> <ul style="list-style-type: none"> <li>+ ? - U Uses equipment or materials appropriate to related fields without specifying necessary modifications.</li> <li>+ ? - U His unique methods amaze supervisors.</li> <li>+ ? - U Gets confused under pressure.</li> <li>+ ? - U Somewhat conceited.</li> <li>+ ? - U Organizes his work well.</li> </ul>	<p>46.</p> <ul style="list-style-type: none"> <li>+ ? - U Turns out accurate work.</li> <li>+ ? - U Messes up.</li> <li>+ ? - U Knows whether an answer to a mathematical calculation is reasonable.</li> <li>+ ? - U Develops own methods when necessary.</li> <li>+ ? - U Will accept temporary solution to an urgent problem.</li> </ul>

## PART II. SUMMARY OF RECOMMENDATIONS

Please summarize your recommendations concerning this applicant by marking each statement below as follows: Circle

- + if the applicant is exceptional or outstanding in the area.
- 0 if he is adequate, or about average for a worker at his level.
- if he is deficient, or below average for a worker at his level.
- U if you do not know him well enough to rate him in the area.

- |  |         |
|--|---------|
| 1. Technical background and experience . . . . .   | + 0 - U |
| 2. Executive ability, i.e., ability to formulate and<br>execute policies, to organize and direct the<br>work of others . . . . . | + 0 - U |
| 3. Potential level of development . . . . .  | + 0 - U |
| 4. Ability to get along with people . . . . .  | + 0 - U |
| 5. Ingenuity, creative ability, inventiveness . . . . .  | + 0 - U |
| 6. Educational background . . . . .  | + 0 - U |

REMARKS. Use this space to describe the applicant in any area you have marked + or - above, giving specific examples of what he has done or failed to do which led you to rate him as you did. Are his major strengths and weaknesses adequately described above? Give any information needed to make this description of the man complete and pertinent. Attach an additional sheet if more space is needed.

Please supply the following information:

How long have you  
known the applicant? \_\_\_\_\_ In what capacity? \_\_\_\_\_

What was your relationship to him? \_\_\_\_\_

Your name \_\_\_\_\_

College or Firm \_\_\_\_\_

Address \_\_\_\_\_

## APPENDIX B

SAMPLES OF MATERIALS USED FOR  
ADMINISTRATION OF  
INFORMATION SHEETS

AMERICAN COUNCIL ON EDUCATION  
744 JACKSON PLACE  
WASHINGTON 6, D. C.

April 5, 1949

Dear Professor:

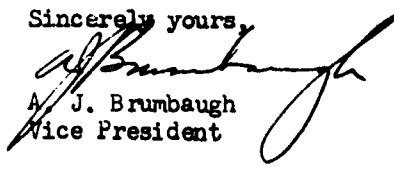
The Navy, in developing its scientific research program, has been interested in a more effective method of selecting its scientific and technical personnel. To this end, the American Council on Education has contracted with Richardson, Bellows, Henry & Co., Inc., a nationally recognized firm of industrial psychologists, to develop a more objective and empirically valid recommendation blank to be used as an aid in the selection of scientists.

A highly important phase of this research is the present one, the collecting of certain empirical data on individuals now engaged in similar work, as a faculty member, an advanced student, or the employee of some business or government agency. We are asking you to aid us in this work.

You are requested to fill in the three enclosed forms, and mail them in the envelope provided. Because the work on this contract must be completed by May 31, 1949, your immediate attention to this will be appreciated. These forms should be filled out by you or some other member of your staff who has had experience in recommending science graduates for positions. The judgments should be those of an individual, not a consensus.

Please accept our thanks for helping in this study.

Sincerely yours,

  
A. J. Brumbaugh  
Vice President

AJB:lb

Enclosures:

Information Sheets A, B, and C  
Instructions

*Thirty-second Annual Meeting, May 6-7, 1949, Hotel Mayflower, Washington, D. C.*

# INSTRUCTIONS

The purpose of the Information Sheets is to find out how effective the qualities reflected by the words and phrases may be in describing scientists. The information which you contribute will enable us to combine only the more effective descriptive phrases (as shown by you and others) into a recommendation form.

1. Please rate two of your former students (either graduate or advanced undergraduate) on the appropriate Information Sheet. The first of these students should be one of the very BEST you have had during the past five years. The other, while completing the required academic work, should be one of the POOREST you have had during this same period.

Rate the better of these two students on the Information Sheet stamped BEST, and the other on the Information Sheet stamped POOR.

Do not name these students on the rating forms, but be sure that you are rating real persons, and not a "composite" student reflecting the attributes of many people.

The rating should be done as follows:

In the space at the left of each statement or descriptive phrase, write:

- 5 - if the statement or description fits the person exactly.
- 4 - if the statement or description fits the person well.
- 3 - if the statement and its opposite are about equally true of that person.
- 2 - if the statement is a rather poor description of the person.
- 1 - if the statement or description does not at all fit that person.

Make a judgment for each item. If some judgments are difficult, make a note of it at the end of the list.



2. On the third Information Sheet, please rate each of the statements in terms of the desirability of being so described. In other words, how "good" is it to be called these various things. Put your ratings in the space at the left of each statement or descriptive phrase as follows:

- 5 - if the statement or description could be said only of outstandingly competent or promising scientists.
- 4 - if the statement or description is primarily applicable to scientists or students of above average competence or promise.
- 3 - if the statement or description is primarily applicable to scientists or students of average competence or promise.
- 2 - if the statement or description is primarily applicable to scientists or students of less than average competence or promise.
- 1 - if the statement or description could be said only of scientists or students of no more than minimally acceptable competence or promise.
- 0 - if the statement or description could be said only of individuals who so lack competence that they cannot be called scientists.

Make a judgment for each item. If some judgments are difficult, make a note of it at the end of the list.

3. As soon as you have completed the three Information Sheets, put them in the enclosed envelope and mail them to Dr. Harold A. Edgerton, Richardson, Bellows, Henry and Company, Inc., 224 East 33rd Street, New York 16, New York.

A

# INFORMATION SHEET

Prepared by

RICHARDSON, BELLOWS, HENRY & COMPANY, INC.

for

THE AMERICAN COUNCIL ON EDUCATION

Project REH-162--

Construction of an Experimentally  
Validated Recommendation Blank to  
Aid in the Selection of Scientists

Project Director--  
Harold A. Edgerton

***BE SURE TO READ THE INSTRUCTIONS!***

1 <input type="checkbox"/> Stickler for details.	21 <input type="checkbox"/> Continuous investigation made him
2 <input type="checkbox"/> Handles many types of problems well.	local expert on special subject.
3 <input type="checkbox"/> Handles several jobs at a time well.	22 <input type="checkbox"/> Easy to talk to.
4 <input type="checkbox"/> Does routine work well.	23 <input type="checkbox"/> Constantly asks others to solve his
5 <input type="checkbox"/> Makes computational errors.	own problems.
6 <input type="checkbox"/> Evaluates work only in terms of ob-	24 <input type="checkbox"/> Insists on working on unproductive
jectives.	problems.
7 <input type="checkbox"/> Fails to simulate practical conditions	25 <input type="checkbox"/> Dogged persistence.
in a laboratory test.	26 <input type="checkbox"/> Needs to be more decisive.
8 <input type="checkbox"/> Has trouble grasping things rapidly.	27 <input type="checkbox"/> Self-centered.
9 <input type="checkbox"/> Good at mental calculations.	28 <input type="checkbox"/> Lets details
10 <input type="checkbox"/> Employs graphical solutions well.	29 <input type="checkbox"/> Fails to
11 <input type="checkbox"/> Usually gets the right answer.	30 <input type="checkbox"/>
12 <input type="checkbox"/> Efficiency "expert".	
13 <input type="checkbox"/> Reports are the poorest part of his	
work.	
14 <input type="checkbox"/> Apathetic.	
15 <input type="checkbox"/> Slow to find fault with	
16 <input type="checkbox"/> Failure	
17 <input type="checkbox"/>	
18 <input type="checkbox"/>	

SAMPLE INFORMATION SHEET

## APPENDIX C

SAMPLES OF MATERIALS USED FOR  
ADMINISTRATION OF  
SEMI-FINAL FORMS

Richardson, Bellows, Henry & Company

INCORPORATED

224 EAST 33RD STREET, NEW YORK 16, N. Y.

TELEPHONE MU. 6-1436

May, 1949

Dear Sir:

Various government agencies employing scientific personnel are cooperating with the Office of Naval Research and the American Council on Education in a study of the validity of methods of securing references on applicants for technical positions. Scientists participating are asked to rate two of their subordinates on the attached forms.


You will note that the task of describing the person is separated from that of evaluating his ability. By doing this it is possible to objectify the evaluation to a degree not otherwise possible.

You are asked to rate two of your subordinates. The first of these, one of the best scientific workers you have ever had under your direction, is to be rated on the form stamped "Best." The form stamped "Poor" is to be used for the rating of one of the least adequate scientific workers you have directed. The "Poor" scientist, while up to the minimum standards of acceptability, would be one you would just as soon do without, but still is not poor enough to be discharged.

Certain data are required for each individual, who will be otherwise unidentified. Place, on the upper right hand corner of the cover page, the person's professional level (e.g., P4, P5, etc.), his field of specialization, academic degrees held -- with major subject, the number of persons supervised directly, and the number supervised indirectly.

Your cooperation is greatly appreciated.

Very truly yours,

  
Harold A. Edgerton  
Vice President

HAE:PH

RECOMMENDATION BLANK  
*SCIENTIFIC AND TECHNICAL POSITIONS*  
FORM E (SEMI-FINAL)

Prepared by  
RICHARDSON, BELLOWS, HENRY & CO., INC.  
for  
THE AMERICAN COUNCIL ON EDUCATION

Project REH-162--  
Development of an Experimentally  
Validated Recommendation Blank to  
Aid in the Selection of Scientists

Project Director--  
Harold A. Edgerton

This form is a part of the second phase of an investigation of methods for evaluating the abilities of applicants for scientific positions. The content has been derived from an analysis of the Information Sheets mailed to some of you on April 5, 1949. The forms will be further refined and shortened as a result of this validation phase of the investigation.

There are two sections in this form. Complete them in order as printed. Do not make changes in the text before responding. You will have an opportunity to make any suggestions for changes under REMARKS in the last section, or to include anything you thing should be added.

SAMPLE COVER PAGE SEMI-FINAL FORMS

INSTRUCTIONS AND BLOCKS ARE SIMILAR TO THOSE IN FINAL FORMS 1-F AND 2-F.

# SCIENTIFIC PERSONNEL CHECK LIST

## FORM G (SEMI-FINAL)

Prepared by

RICHARDSON, BELLows, HENRY & CO., INC.

for

THE AMERICAN COUNCIL ON EDUCATION

Project RBH-162—  
Development of an Experimentally  
Validated Recommendation Blank to  
Aid in the Selection of Scientists

Project Director—  
Harold A. Edgerton

This form is a part of the second phase of an investigation of methods for evaluating the abilities of applicants for scientific positions. The content has been derived from an analysis of the Information Sheets mailed to some of you on April 5, 1949. The forms will be further refined and shortened as a result of this validation phase of the investigation.

This form consists of fifty statements which are descriptive of scientists. Rate the man on the basis of his performance as a scientist as follows:

In the space at the left of each statement, circle

- + if the statement is a good description of the person.
- ? if the statement and its opposite are about equally true of the person.
- if the opposite of the statement is a good description of the person.
- U if you are unable to make a judgment.

One symbol is to be circled for each item. If some items are difficult, make a note of it under REMARKS at the end of the list.

SAMPLE COVER PAGE SEMI-FINAL FORMS

ITEMS ARE SIMILAR TO THOSE IN FINAL FORM 3-N

## APPENDIX D

### SUGGESTIONS TO USING AGENCIES

## A. INTRODUCTION

1. The reference or recommendation blank is a device to secure the opinion of a qualified person in regard to the suitability of an applicant for a job. Reference blanks have ranged from a brief request to "please tell me about Bill Smith" to elaborate series of questions to be answered regarding him. Such reference blanks are difficult to evaluate, frequently inadequate in their coverage, full of stereotyped phrases, and frequently give little pertinent information.

2. In order to provide reference blanks which will be less susceptible to the above criticisms, three objective forms have been constructed:

Forms 1-F and 2-F consist of 20 blocks of forced-choice items.

Form 3-N consists of 50 non-forced choice items of the check-list type.

Part I of these three forms is intended to serve only as a "common denominator" in reference blanks to be used for selection of scientific personnel. Other pertinent information must also be obtained and evaluated. The suggested forms in Appendix A illustrate some types of materials that might be included. It is important that Part I always be used without change, for even minor modifications will seriously effect the validity and reliability of the blanks. Part II should be modified to meet the specific needs of the agency using the form.

3. The primary characteristic of the forms developed is that they differentiate between the more and less competent scientists and engineers. The forms are adaptable for recommendations by faculty members of their students, or by supervisors of scientific work in government or industry. Finally, the forms are reasonably easy to use.

## B. USE OF THE FORMS

1. The use and interpretation of any of the three forms (1-F, 2-F, and 3-N) depends greatly upon the purposes for which the scores will be used. In general, they will be used for:

- a. "Selecting out," that is, eliminating applicants from further consideration. When used in this way, a low cutting score should be used in order to eliminate the most inadequate applicants and also to leave a sufficient number to allow for failures of later hurdles. This is probably the most important use of the recommendation form, particularly when large numbers of applicants must be considered, or when later testing and interviewing involve considerable expenditures of time and money.
- b. Selection of a few applicants for intensive follow-up, particularly when only a small number of openings are available. In this case, the highest-scoring applicants are considered. Obviously, a careful screening is necessary in addition to scores on the recommendation forms.



It is obvious that the recommendation blanks will be most effective in selecting either the very best or the very poorest from a group of applicants. As it becomes necessary to increase the proportion of applicants passing this hurdle of selection, a greater portion of persons of moderate ability will be selected. The exact proportions cannot be stated, since the experimental samples were restricted to the "best" and "poorest" subordinates of the reporting scientists.

2. It is recommended that any agency using any of the forms 1-F, 2-F, or 3-N use all of them. This means, of course, that they will have three different forms available for use. In actual practice, a different form should be sent to each person named as reference, so as to obtain a greater validity than would be possible if all the references were sent the same form.

### C. INTERPRETATION

1. Part I. Norms are not available for the scores on these objective forms, although limited information is given in Appendix E and page 5 of the report. These distributions of scores were obtained for a "best" and a minimally satisfactory group of scientists. Each using agency will need to accumulate its own experience and set its own norms of minimum scores in light of its experience, policies, and purposes.

2. Part II. Part II is not objectively scorable, but the information given should be carefully considered. Persons writing recommendations frequently feel that they have not adequately described an applicant if they have only checked a carefully limited list of items, but are willing to give much meaningful information in response to general questions. Also, it has been shown that ratings of this type are actually more valid when they follow the forced-choice section.

3. Consistency of the reports can be estimated by consideration of score on Part I and general tone on Part II. Thus, a recommendation would be suspect if a person obtained an extremely high score on Part I and had only minimally satisfactory work history, training, background, etc. Similarly, if the objective score is high, then strong favorable statements regarding the applicant would be credible, but, if the objective score is low, a strongly favorable statement or tone in the recommendations should be very carefully scrutinized.

4. The distributions of scores in the report (page 5) and in Appendix E reveal no significant difference between the forms in either mean score or standard deviation, and they may therefore be considered to be equivalent forms of the same instrument. No data were available for study of the intercorrelations of the three forms.

### D. SCORING KEYS

1. The strength of the more objective type of recommendation form lies in the fact that the reference describes the applicant but does not evaluate his descriptions. Evaluation is done by means of a scoring key, and is done only by the agency to whom the recommendation blank is sent. This is essential since a knowledge, on the part of the reference, of the weights attached to each response would soon make the blanks useless.

2. Two keys were constructed for each form -- Key 1, a cross-validated key, and Key 2, an experimental key which needs further study.

3. Scoring keys are available only to using agencies and may be obtained upon request to the Human Resources Division, Office of Naval Research.

#### E. CHARACTERISTICS OF THE BLANK

1. Any procedure or device used in the selection of personnel should have two known characteristics:

- a. Validity, i.e., it should discriminate between the kinds of applicants desired and those not so well qualified for the job.
- b. Reliability, i.e., it should produce consistent results.

The validity and reliability of Part I of these recommendation blanks are shown in Appendix E. Both are adequately high. From the experience of the contractor, it would be expected that both the validity and reliability of Forms 1-F and 2-F will remain slightly higher than for Form 3-N.

2. The usual defects of ratings will appear to a lesser extent in a forced-choice form than in a non-forced-choice form.

#### F. SUMMARY OF RECOMMENDATIONS

1. The recommendation blanks developed in this study should be adopted for use as an aid in selection and placement of scientific and engineering personnel in Navy installations. While the blank will be of value in other situations, further investigation should be made in order to set standards for minimum acceptability of applicants.

2. This device, as is true of other selection techniques, can be used in at least two ways:

- a. To eliminate only the poorest of the applicants, and
- b. To accept only the best of the applicants.

The manner in which it is to be used will depend on the policy of the using agency. If the score is to be combined with the scores on the remainder of the selection procedure, it will be necessary to undertake the necessary investigation to determine the appropriate weight to be assigned this device.

3. The cross-validated scoring key (Key 1) should be used in preference to Key 2. Key 1 is more stable and has sufficient variability in the scores for any practical use. Key 2 might be subjected to further study, but the gains which will accrue from this investigation are problematical.

## G. BIBLIOGRAPHY

For those who wish to read further regarding these kinds of procedures, several selected references are suggested below.

### References regarding recommendation blanks:

- Bills, M.A., "Trends in Selection for Employment," Personnel, 1939, 15, pp. 124-93.  
Knox, F.M., "A Guide to Personnel Record Keeping," Personnel, 1942, 18, pp. 540-61.  
Newer, B.S., "Employment Prospects," Personnel Journal, 1944, 23, pp. 135-44.

### References regarding forced-choice performance reports:

- Bittner, R.H., "Developing an Employee Merit Rating Procedure," Personnel, 1949, 25, pp. 275-91.  
Rundquist, E.A., and Bittner, R.H., "Using Ratings to Validate Personnel Instruments," Personnel Psychology, 1948, 1, pp. 163-83.  
Sisson, E. Donald, "Forced-Choice -- The New Army Rating," Personnel Psychology, 1948, 1, pp. 365-81.  
Staff, Personnel Research and Procedures Branch, Adjutant General's Office, "Forced-Choice Technique and Rating Scales," American Psychologist, 1946, 1, p. 267.

## APPENDIX E

SUPPLEMENTARY DATA  
ON RELIABILITY AND VALIDITY OF THE FORMS

### A. GENERAL INFORMATION

The methods used in the construction and validation of the objective form of recommendation blanks are those which have been developed in connection with forced-choice performance reports. Certain additional information regarding the validity and reliability of the instruments is presented in this section.

### B. RELIABILITY

The reliability of the three forms has been estimated, using the split-half method. Estimates are based on both sets of scoring keys. Because of the use of contrasting groups, split-half reliability coefficients were computed separately for the "best" and "poor" groups. The estimates shown in the table were obtained by taking the arithmetic mean of the split-half coefficients for the contrasting groups and then applying the Brown-Spearman Prophecy Formula. These estimates of reliability are therefore probably quite conservative.

TABLE 1

#### Estimates of Reliability

Form	Estimated Reliability	
	Key 1	Key 2
1-F	.79	.81
2-F	.84	.83
3-N	.77	-

### C. SCORING KEYS

Two scoring keys were developed for each of Forms 1-F and 2-F. Only one scoring key was constructed for Form 3-N. Key 1 for Forms 1-F, 2-F, and 3-N was constructed in the light of the item discrimination shown by the analysis of the Information Sheet. These scoring keys were applied to a sample of government scientists for whom the semi-final forms were accomplished. Using this different kind of sample is a cross-validation of the scoring key. The discrimination between "best" and "poor" groups were shown in Tables 1 and 2 on page 5 of the report.

Because of the competition of items within the relatively closed system of forced-choice, the analysis of the data showed that additional items in each of the blocks could be scored. On this basis, Key 2 was developed for Forms 1-F and 2-F. When these keys were used to score the blanks in the validation sample, there was a significant increase in the variability of the scores relative to Key 1 for Forms 1-F and 2-F, but there was no significant change in either of the means. Table 2 summarizes the distribution of scores on these keys.

TABLE 2

Distribution of Scores for the Validation Sample  
Using Key 2 for Forms 1-F and 2-F

Score	Form 1-F		Form 2-F	
	"Best"	"Poor"	"Best"	"Poor"
76-80	17		16	
72-75	27		31	
68-71	16		15	
64-67	11		5	
60-63	6		7	
56-59	3		2	
52-55		1		1
48-51				1
44-47		4	2	1
40-43		2		1
36-39		3		2
32-35		8		4
28-31		3		6
24-27		6		6
20-23		3		6
16-19		13		9
12-15		12		17
8-11		4		6
4-7		16		2
0-3		4		5
N	80	79	78	67
M	44.8		46.7	
$\sigma$	27.6		27.1	

A sample of 52 recommendations was excluded from all of the analyses in order to cross-validate Key 2 for Forms 1-F and 2-F. While this sample is small, the results are similar to those obtained with the validation sample (Table 2), and it is, therefore, possible to have confidence in the validity of Key 2 for Forms 1-F and 2-F in the scoring of the reference blank. The scores for this cross-validation sample are shown in Table 3.

TABLE 3

Distribution of Scores for the Cross-Validation Sample  
Using Key 2 for Forms 1-F and 2-F

Score	Form 1-F		Form 2-F	
	"Best"	"Poor"	"Best"	"Poor"
76-79	2			
72-75	2			
68-71	3			
64-67	2		5	
60-63			2	
56-59	1		1	
52-55			2	
48-51	1			
44-47			1	
40-43				
36-39				1
32-35				1
28-31				5
24-27		2		4
20-23		3		2
16-19		6		
12-15		2		1
8-11		1		1
4-7		1		
0-3				
N	11	15	11	15

For each of the semi-final forms completed, the items were tabulated for professional level and for professional field (physics, chemistry, mathematics, engineering). These tabulations showed almost no differences among the professional fields. Distribution of items checked showed little difference for professional field.

Within the scope of the sample studied, it is possible to conclude that the recommendation blank can be used to aid in differentiating the more effective scientists from the less effective, without having to use a different scoring key or different norms for professional level or professional field. It was hoped that the recommendation forms would function in this fashion, letting detailed information, specific to a field and to professional level, be obtained by questions designed to obtain such information and by study of the applicant's record.